Climate models: an essential tool for guiding policy

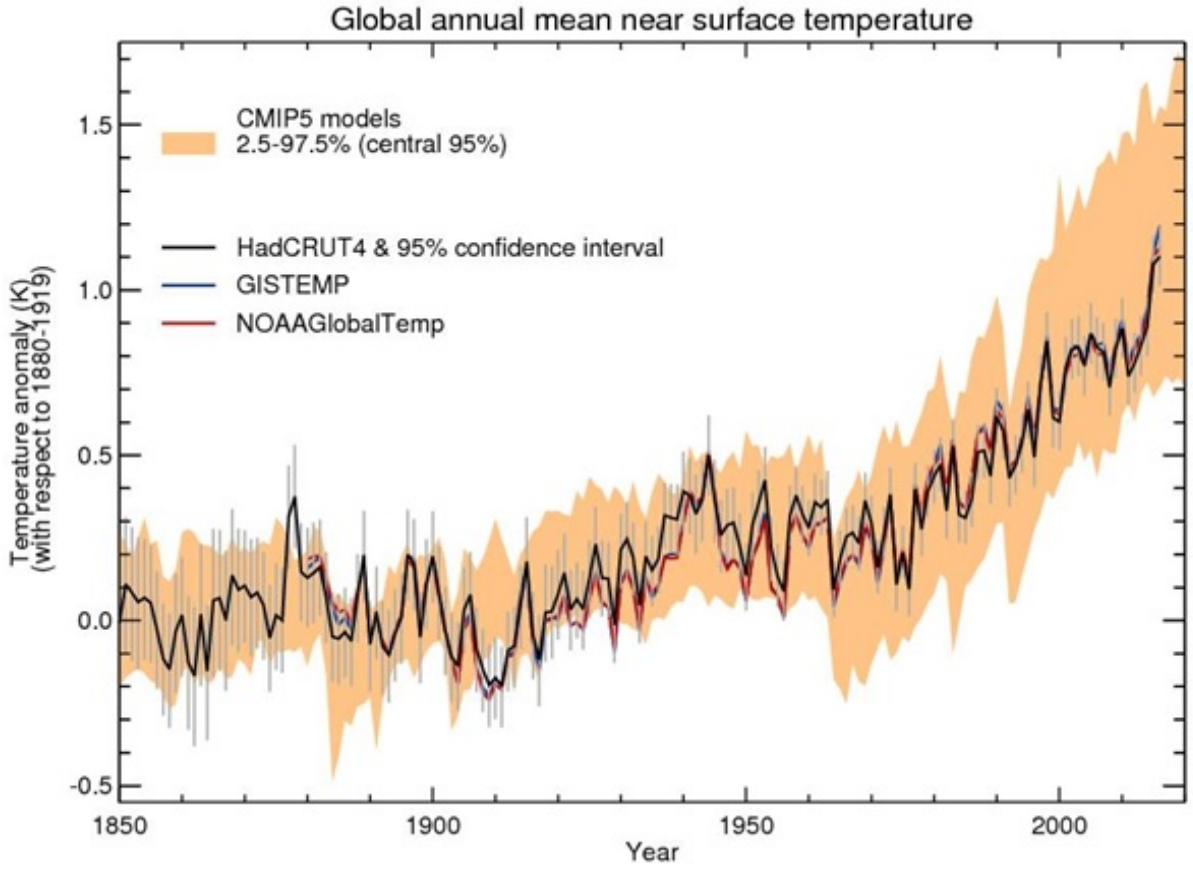
Description

Climate models have come under scrutiny. Stephen Belcher, the Met Office's Chief Scientist, explains the nuances of the science and why it is imperative now to reduce atmospheric carbon.

Are climate models accurately predicting global warming?

This question has been a hotly debated this week. Whilst climate models do not represent all aspects of our climate, they provide an essential tool for guiding policy by simulating the warming we have seen since the pre-industrial era. So how well do they do?

The figure below shows observations of global warming (in black) compared to the range projected by the group of models submitted to CMIP5, which was used by the IPCC for their latest assessment report on climate change. The 1880-1919 period was chosen here to represent pre-industrial temperatures so that three observational data sets could be used in the comparison. The observations lie comfortably within the modelled range. For example, the warming seen between the 1880-1919 period and 2016 is 1.10^{o}C in HadCRUT4, 1.19 ^{o}C in GISTEMP and 1.12 ^{o}C in NOAAGlobalTemp, which compares well with 1.14 ^{o}C, the average of the CMIP5 models (which have a 2.5 – 97.5% range of 0.70 – 1.58 ^{o}C).



Comparison of simulated temperatures from CMIP5 models (historical and RCP4.5 experiments) with three observed near-surface temperature datasets, as changes from the 1880-1919 baseline. The observational datasets are HadCRUT4 (with an estimate of the uncertainty on the dataset) produced by the Met Office Hadley Centre and the Climate Research Unit; GISTEMP produced by NASS GISS; and NOAAGlobalTemp produced by NOAA. The model and observational data have been re-analysed to the same coverage as HadCRUT4 to enable fair comparison.

What factors need to be considered in making comparisons between observed and modelled warming?

First, during the so-called slowdown during the 2000s the observations sit within the lower half of the model range. This has prompted questions about whether the models have been warming too much. Analysis at the Met Office shows that these variations are consistent with variations associated with the Pacific Decadal Oscillation. We have since seen record-breaking temperatures in 2014, 2015 and 2016 which signal an end to the slowdown and a return of higher warmer rates.

Second, the CMIP5 simulations were initiated in 2005, and emissions of greenhouse gases from 2005 onwards were assessed, based on estimates for socio-economic development. So the CMIP5 simulations do not account for the cooling effects of small volcanic eruptions which recent research shows slightly cools the modelled warming. (Further information on these topics can be found in Ed Hawkins' blog, and in the Nature journal paper by Medhaug et al)

Third, the observations themselves contain uncertainties, for example due to difficulties of estimating temperature changes in poorly-observed regions such as the Arctic and Antarctica, and due to definition of the pre-industrial temperature, when the observations have greater uncertainties.

So can we limit warming to the ambitions of the Paris agreement?

Policy makers need to have reliable information about greenhouse gas emissions because there is a direct link between the amounts of total CO2 we have emitted and the amount our world warms. By studying this link, it is possible to estimate how much more carbon we can emit while remaining within given levels of warming. There is currently an intense research effort to reduce the current uncertainties in the carbon budget.

One recent study has suggested that remaining carbon budgets may be larger than previously thought. (The close agreement between the models and the observations in the figure above does not change this conclusion.) Meanwhile other areas of research suggest they may be smaller. For example, the next generation of climate models will include processes such as the impacts of thawing permafrost, changes to wetlands, and the impact of the nitrogen cycle on plant growth. Early evidence suggests that accounting for these processes will reduce the amount of carbon we can emit while staying within the over all budget and the global warming targets.

The Paris Agreement to limit warming to 'well below 2 ^{o}C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 °C' is driving a need for greater precision in climate science, both in the need to assess warming above pre-industrial levels, and in the need to assess carbon budgets consistent with these targets.

What remains clear, however, is that the aim of limiting warming to 1.5C remains a huge global challenge that requires rapid cuts to greenhouse gas emissions.

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Harnessing the power of the weather forecast

Description

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Using data from the Met Office, today National Grid, in cooperation with the Environmental Defence Fund Europe (EDF) and WWF, have launched a forecast to enable the public and businesses to better understand and plan their energy use.

Using hourly weather data from the Met Office and combining it with historical data from the grid, National Grid are able to forecast demand for electricity and also identify the contribution from renewable energy flowing into the grid. Using this information, they can forecast the carbon output of the grid over a 48-hour period, and identify the periods of lowest carbon output and highest carbon output. In other words, how green the grid will be during that period.

Using this information, the partners involved in the project hope that electricity consumers across Great Britain will be able to plan their electricity use around periods of high availability for renewable energy, reducing carbon output.

Patrick Sachon, Met Office Business Group Leader for Energy said: “The green energy forecast is a great example of innovative re-use of Met Office data. As a scientific organisation we encourage the re-

use of our data, particularly if it can be applied to develop a deeper understanding of the interrelation between weather and something that is so integral to our everyday lives such energy."

Accessibility of the new green energy forecast is important to the project partners and they have made it available as an API (application programming interface) so it can be used to develop new apps and services. Duncan Burt, Director of the System Operator at National Grid, said: "We're providing our forecast data in a format that allows technology companies to build innovative apps and software that could make a real difference to how and when people use energy. Clear and concise information that can tell you in advance when's best to turn on the washing machine, load the dishwasher or charge your car for example, is a step in the right direction towards a low carbon future. This technology puts people at the heart of it, helping everyone to use power when it's greenest, and likely, more cost efficient".

Patrick Sachon said: "We look forward to continuing to work closely with National Grid to explore how our weather data can be used to better understand energy use."

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Atlantic depressions bring above-average rain for some

Description

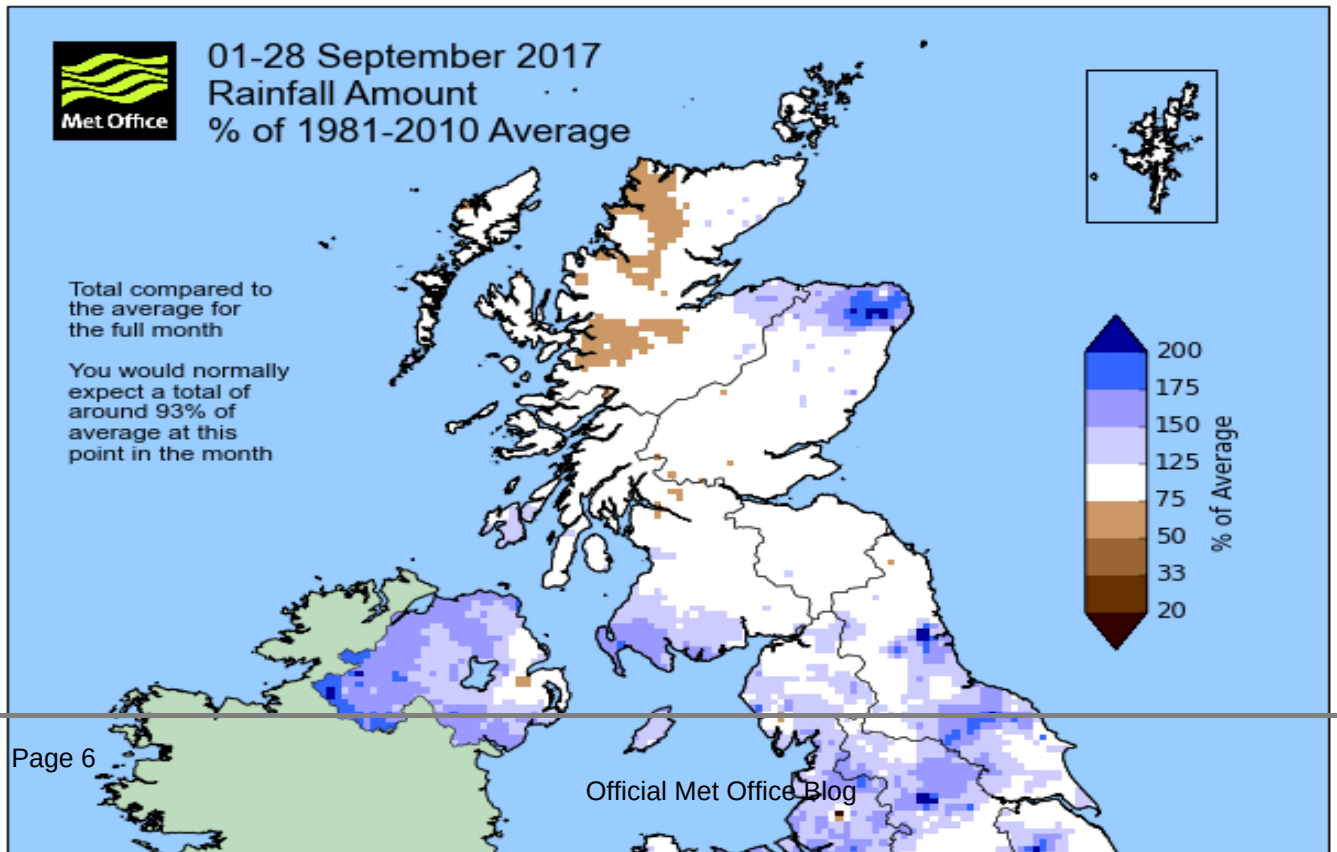
During the first half of the month, a succession of low-pressure systems tracking close to the UK brought rain to most places as fronts swept from west to east. After a cool, showery interlude around mid-month, a more autumnal pattern emerged with some foggy nights and sunny days interspersed with further bouts of rain.

Following August's trend, provisional statistics for the UK for September so far suggest it has been slightly cooler than average and rather unsettled, although frosts have been reported by very few stations up until 28 September. The cool trend isn't apparent everywhere though, as parts of northern Scotland, including Shetland, Orkney and Caithness were the warmest spots relatively in Britain, when compared with average temperatures. Shetland enjoyed mean temperatures during the month more than 1 °C above the long-term September average. In contrast, the maximum daily temperatures in some parts of southern England were around 1 °C cooler than the September average.

Dr Mark McCarthy is the head of the Met Office's National Climate Information Centre. He said: "The UK receives weather influences from all points of the compass. However, the weather during September has been largely dominated by an influence from the Atlantic. This is evident in the above-average rainfall in parts of western Britain and Northern Ireland. The relative lack of northerly winds will have been partly responsible for keeping the temperatures of parts of northern Scotland above average."

Up until 28 September, most places had already exceeded their average rainfall for the month, with a UK figure of 108.1mm with two days to go (UK September average is 96.4mm). Some locations, such as Cornwall and Plymouth, have had well above their September rainfall average.

Dr Mark McCarthy added: "Cornwall has experienced it wettest September since 2000 and there is



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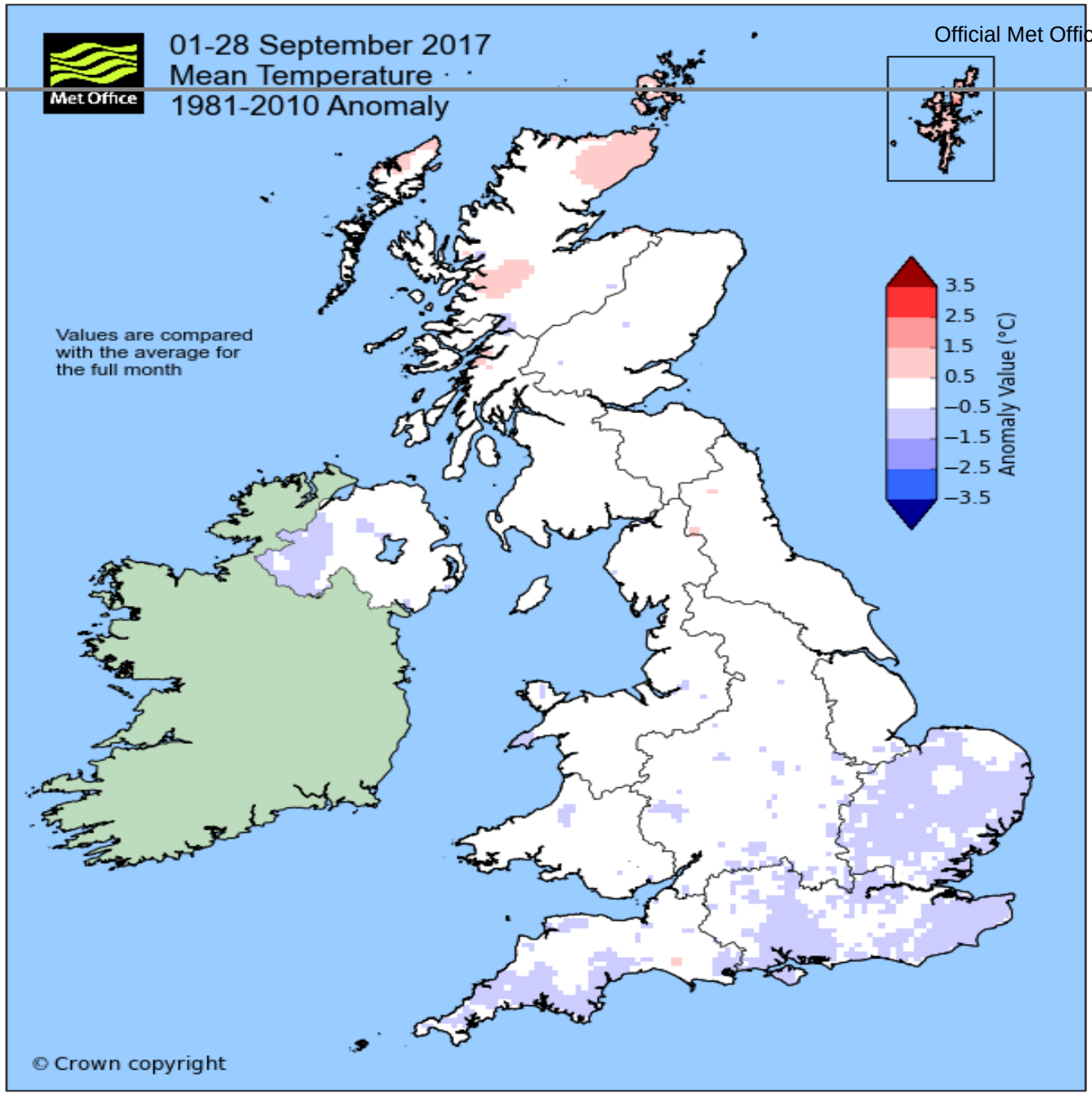

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rainfall amounts generally above average, it’s no surprise that sunshine hours are below or close to average for most areas, with the exception of parts of southeast England near the Thames Estuary. UK sunshine amounts are 102.6 hours, 82% of average (124.7 hours) up until 28 September.

The forecast for the last days of September is changeable, with some persistent and heavy rain forecast for many areas as we head into the final night of the month. This means that rainfall amounts may increase substantially for some areas, while there is unlikely to be a surge of warmth to counteract the cool feel so far.

1-28 September 2017 provisional figures	Mean temp (°C)		Rainfall (mm)		Sunshine (hours)	
	Actual	Diff to avg (°C)	Actual	% of avg	Actual	% o
UK	12.5	-0.2	108.1	112	102.6	82
England	13.4	-0.3	84.3	121	114.3	83
Wales	12.6	-0.2	149.5	128	96.4	75
Scotland	11.1	0.2	131.0	96	86.0	82
N Ireland	12.0	-0.3	137.6	150	95.6	84

You can keep up to date with the weather using our forecast pages, on our popular mobile app which is available for iPhone from the App store and for Android from the Google Play store and by following us on Twitter and Facebook, as well as using.

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